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Journal of the Society of Arts.

FRIDAY, JULY 11, 1862.

INTERNATIONAL EXHIBITION OF 1862.

GUARANTEE.

The Council beg to announce that the Guarantee Deed is still lying at the Society's House for signature, and they will be much obliged if those gentlemen who have given in their names as Guarantors, as well as others interested in the Exhibition, will make it convenient to call there and attach their signatures to the Document. Signatures for sums amounting in the aggregate of £452,100, have been attached to the Deed.

SEASON TICKETS.

Season Tickets may be obtained at the Society's House, on application to Mr. S. T. Davenport, Financial Officer. The prices of the tickets are as follows:—£2 10s., admitting to the International Exhibition and the Gardens of the Royal Horticultural Society every day during the remainder of the season; £1 10s., admitting to the Exhibition only, every day; and 10s., admitting to the Exhibition on shilling days only.

CONVERSAZIONI.

The second *Conversazione* of the present season took place on Wednesday evening, the 9th inst., at the South Kensington Museum. There were upwards of 4,500 persons present.

His Royal Highness the Grand Duke of Saxe Weimar, His Serene Highness and Her Royal Highness Prince and Princess Hermann of Saxe Weimar, their Serene Highnesses Prince and Princess Edward of Saxe Weimar, His Serene Highness the Prince of Lichtenstein, and His Serene Highness Prince George of Solens-Braunfels, honoured the Society with their presence.

The First Choir of the National Choral Society, under the direction of Mr. G. W. Martin, performed a Selection of Part-Songs, Glees, &c., and Distin's Ventil Horn Union played a Selection of Music.

The third *Conversazione* of the season will take place on Wednesday, the 8th October.

CENTRAL COMMITTEE OF EDUCATIONAL UNIONS IN CONNEXION WITH THE SOCIETY OF ARTS.

MEMBERS OF THE COMMITTEE.

EDWIN ADAMS, Esq., M.R.C.P., Chelmsford Local Educational Board.

The Rev. THOMAS BACON and the Hon. and Rev. S. BEST, Honorary Secretaries of the Southern Counties Adult Educational Society.

BARNETT BLAKE, Esq., Agent of the Yorkshire Union of Mechanics' Institutes.

HARRY CHESTER, Esq., Vice-President of the Society of Arts.

The Rev. SAMUEL CLARK, Chairman of the Central Board of Examiners of the Society of Arts.

The Rev. C. D. GORDIE, Member of the Committee of the Bucks and Berks Adult Education Society.

The Hon. and Rev. GODOLPHIN HASTINGS, M.A., Vice-Chairman of the Hertford Local Educational Board.

The Rev. DAVID MELVILLE, Member of Council, JOHN SLANEY PAKINGTON, Esq., President of the Worcester-shire Union of Educational Institutions.

WM. NEWMARCH, Esq., Notting-hill Working Men's Association.

Sir THOMAS PHILLIPS, F.G.S., Chairman of the Council, and SAMUEL REDGRAVE, Esq., Treasurer of the Society of Arts.

M. H. MARSH, Esq., M.P., Vice-President of the Society of Arts.

BARROW RULE, Esq., M.R.C.P., Aldershot District Local Educational Board.

F. TALBOT, Esq., South Staffordshire Union of Educational Institutions.

JOHN JONES, Esq., Secretary and Organizing Master to the South Staffordshire Union of Educational Institutions

I. The Central Committee consists of two representatives of each Provincial and District Union and Adult Educational Society, four members of the Council of the Society of Arts, the Chairman of the Society's Central Board of Examiners, and six representatives of Local Educational Boards.

II. The object of the Central Committee is to promote uniformity of action and a fixed standard in the Elementary Examinations held by the various bodies in connexion with the Society of Arts.

III. The Central Committee provides for common use a scheme of two Elementary Examinations, consisting of two sets of papers, one suited for junior, the other for senior candidates, with corresponding Forms of Certificate, to be awarded by the local authority under which the Examination has been conducted.

IV. The certificate of a Senior Candidate, of sixteen years of age, will be received, without any further "Previous Examination," as a "pass" to the Final Examinations of the Society of Arts, if accompanied by a certificate from the Local Board or Union, that the candidate is fit to be examined in the special subject or subjects in the Society of Arts Programme in which he or she proposes to be examined.

V. The Society of Arts prints and distributes, at cost price, the Examination Papers, Certificates, and Circulars, and provides for the correspondence of the Central Committee.

VI. The Elementary Examinations are not intended to be in any degree competitive. They are open to persons of either sex and of any age.

VII. To prevent the possibility of unfair advantages being taken from a premature knowledge of the Examination Papers, the Examinations must be simultaneous everywhere.

VIII. In 1863 they will be held on Tuesday, the 3rd, Wednesday the 4th, Thursday the 5th, and Friday the 6th of March, after 4 o'clock p.m.

IX. In any case in which a Local Examining Body may examine candidates in the doctrines of Holy Scripture, in the Prayer Book, or in any other religious formulary, the results of such Examination may be stated, by that local Examining Body, on the certificate; though the Central Committee, representing a variety of opinions, does not itself provide for Examinations in religious doctrine.

X. The Secretary of each Union, Society, or Board, which desires to use the Examination Papers of the Central Committee, must apply for the requisite forms on or before the 2nd February, 1863, to "The Secretary, Cen-

tral Committee for Elementary Examinations, Society of Arts, John-street, Adelphi, London, W.C."

SCHEME OF THE EXAMINATIONS FOR 1863.

JUNIOR CANDIDATES.

1. Every candidate must be examined in the first four rules of Arithmetic, simple and compound, and in any two of the three following subjects:—

- A. A general knowledge of the Gospel History.
- B. The rudiments of English History.
- C. The rudiments of the Geography of England.

2. Female candidates must also be examined in plain needle-work.

3. Fair writing and spelling, with good reading of a simple narrative, will be required of every candidate.

4. A satisfactory examination will entitle the candidate to a certificate.

SENIOR CANDIDATES.

1. Every Candidate must be examined in arithmetic, including the Rule of Three, Decimal and Vulgar Fractions, and in any two of the three following subjects:—

- A. The facts of St. Mark's Gospel and the Acts of the Apostles.
- B. English History from the accession of James the First to the death of Anne, with the rudiments of the history from the Conquest.
- C. Geography of the British Isles.

2. Every female candidate must show proficiency in needle-work.

3. All candidates will be required to exhibit in their papers a fairly good handwriting, spelling, and knowledge of grammar.

4. A satisfactory examination will entitle the candidate to a certificate.

By order,

P. LE NEVE FOSTER,

Secretary to the Central Committee.

Society of Arts, John-street, Adelphi,
London, W.C., July, 1862.

ON THE PROPERTIES OF IRON, AND ITS RESISTANCE TO PROJECTILES AT HIGH VELOCITIES.

By WILLIAM FAIRBAIRN, F.R.S.

The following is the substance of a paper recently delivered before the Royal Institution:—

We have no correct record as to the exact time when wrought-iron plates were first employed for the purpose of building vessels. It is, however, certain that iron barges were in use on canals at the close of the last century. In 1824, Mr. Manley, of Staffordshire, built an iron steam-boat for the navigation of the river Seine, and this was the first iron vessel that attempted a sea voyage. She was navigated from this country to Havre, by the late Admiral Sir Charles Napier, and although constructed for shallow rivers, she nevertheless crossed the channel in perfect safety. From that time to 1830 no attempt was made to build iron vessels, and nothing was done towards ascertaining the properties of iron as a material for ship-building.

A series of experiments, instituted by the Forth and Clyde Canal Company in 1829-30, to ascertain the law of traction of light boats at high velocities on canals, led to the application of iron for the construction of vessels; and the lightness of these new vessels, combined with their increased strength, suggested the extended application of the material in the construction of vessels of much larger dimensions, and ultimately to those of the largest class, both in the war and mercantile navy. Considerable difficulty, however, existed with regard to the navy; and although the principle of iron construction as applied to merchant vessels and packets was fully established, it was nevertheless considered inapplicable, until of late years,

for ships of war. It is true that until the new system of casing the sides of vessels, first introduced by the Emperor of the French, in 1854, was established, the iron ship was even more dangerous under fire than one built entirely of wood. Now, however, that thick iron plates are found sufficiently strong, under ordinary circumstances, to resist the action of guns not exceeding 120-pounders, for a considerable length of time, the state of the navy and the minds of our naval officers have entirely changed. We must, therefore, now look to new conditions, new materials, and an entirely new construction, if we are to retain our superiority as *mistress of the seas*. There yet remain amongst us those who contend for the wooden walls, but they are no longer applicable to the wants of the state; and I am clearly of opinion that we cannot afford to trifle with so important a branch of the public service as to fall behind any nation, however powerful and efficient they may be in naval construction. Having satisfied ourselves that this desideratum must be attained, at whatever cost, I shall now endeavour to point out such facts as in my opinion relate to the changes that are now before us, and simply endeavour to show—

1st. The description of iron best calculated to secure strength and durability in the construction of ships of war.

2nd. The distribution and best forms of construction to attain this object; and,

Lastly. The properties of iron best calculated to resist the penetration of shot at high velocities.

Properties of Iron.—If we are desirous to attain perfection in mechanical, architectural, or ship-building construction, it is essential that the engineer or architect should make himself thoroughly acquainted with the properties of the materials which he employs. It is unimportant whether the construction be a house, a ship, or a bridge. We must possess correct ideas of the strength, proportion, and combination of the parts, before we can arrive at satisfactory results; and to effect these objects the naval architect should be conversant with the following facts relating to the resisting powers of malleable and rolled iron to a tensile strain.

The resistance in tons per square inch of—

Yorkshire Iron is	24.50 tons
Derbyshire " ..	20.25 "
Shropshire " ..	22.50 "
Staffordshire " ..	20.00 "

Strength of Rivetted Joints.—The architect having fortified himself with the above facts, will be better able to carry out a judicious distribution of the frames, ribs, and plates of an iron ship, so as to meet the various strains to which it may be subjected, and ultimately to arrive at a distribution where the whole in combination presents uniformity of resistance to repeated strains, and the various changes it has to encounter in actual service.

There is, however, another circumstance, of deep importance to the naval architect, which should on no account be lost sight of, and that is, the comparative values of the rivetted joints of plates to the plates themselves. These, according to experiment, give the following results:—

Taking the cohesive strength of the plate at...100	
The strength of the double-rivetted joint was found to be	70
And the single rivetted joint.....	56

These proportions apply with great force to vessels requiring close rivetting, such as ships and boilers that must be water-tight, and in calculation it is necessary to make allowances in that ratio.

Strength of Ships.—Of late years it has been found convenient to increase the length of steamers and sailing vessels to as much as eight or nine times their breadth of beam, and this for two reasons; first, to obtain an increase of speed by giving fine sharp lines to the bow and stern; and second, to secure an increase of capacity for the same midship section, by which the carrying powers of the ship

are greatly augmented. Now, there is no serious objection to this increase of length, which may or may not have reached the maximum. But, unfortunately, it has hitherto been accomplished at a great sacrifice to the strength of the ship. Vessels floating on water and subjected to the swell of a rolling sea—to say nothing of their being stranded or beaten upon the rocks or sandbanks of a lee shore—are governed by the same laws of transverse strain as simple hollow beams, like the tubes of the Conway and Britannia tubular bridges. Assuming this to be true—and indeed it scarcely requires demonstration—it follows that we cannot lengthen a ship with impunity without adding to her depth or to the sectional area of the plates in the middle along the line of the upper deck.

If we take a vessel of the ordinary construction, or what some years ago was considered the best—300 feet long, 41 feet 6 inches beam, and 26 feet 6 inches deep—we shall be able to show how inadequately she is designed to resist the strains to which she would be subjected. To arrive at these facts we shall approximate nearly to the truth by treating it as a simple beam; and this is actually the case, to some extent, when a vessel is supported at each end by two waves, or when rising on the crest of another, supported at the centre with the stem and stern partially suspended. Now in these positions the ship undergoes, alternately, a strain of compression and of tension along the whole section of the deck, corresponding with equal strains of tension and compression along the section of the keel, the strains being reversed according as the vessel is supported at the ends or the centre. These are, in fact, the alternate strains to which every long vessel is exposed, particularly in seas where the distance between the crests of the waves does not exceed the length of the ship.

It is true that a vessel may continue for a number of voyages to resist the continuous strains to which she is subjected whilst resting on water; but supposing in stress of weather, or from some other cause, she is driven on rocks, with her bow and stern suspended, the probability is that she would break in two, separating from the insufficiency of the deck on the one hand, and the weakness of the hull on the other. This is the great source of weakness in wrought-iron vessels of this construction, as well as of wooden ones, when placed in similar trying circumstances.*

Changes in Progress.—Having directed attention to the strength of ships, and the necessity for their improved construction, we may now advert to the changes by which we are surrounded and to the revolution now pending over the destinies of the navy, and the deadly weapons now forging for its destruction. It is not for us alone, but for all other maritime nations, that these Cyclopean monsters are now issuing from the furnaces of Vulcan; and it behoves all those exposed to such merciless enemies to be upon their guard, and to have their *Warriors*, *Merimacs*, and *Monitors* ever ready, clothed in mail from stem to stern, to encounter such formidable foes. It has been seen, and every experiment exemplifies the same fact, that the iron ship with its coat of armour is a totally different construction to that of the wooden walls which for centuries have been the pride and glory of the country. Three-deckers, like the *Victory* and the *Ville de Paris* of the last century, would not exist an hour against the sea-monsters now coming into use.

The days of our wooden walls are therefore gone; and instead of the gallant bearing of a 100-gun ship, with every inch of canvas set, dashing the spray from her bows and careering merrily over the ocean, we shall find in its place a black demon, some five or six hundred feet long, stealing along, with a black funnel and flag-staff, on her mission of destruction, and scarcely seen above water, excepting only to show a row of teeth on each side, as formidable as the immense iron carcass that is floating below.

This may, with our present impressions, be considered a perspective of the future navy of England—probably not encouraging—but one on which the security of the country may ultimately have to depend, and to the construction of which the whole power and skill of the nation should be directed. I have noticed these changes, which are fast approaching, from the conviction that the progress of the applied sciences is not only revolutionizing our habits in the development of naval constructions, as in every other branch of industry, but the art of war is undergoing the same changes as those which have done so much for the industrial resources of the country in times of peace. It is therefore necessary to prepare for the changes now in progress, and endeavour to effect them on principles calculated, not only to ensure security, but to place this country at the head of constructive art. It is to attain these objects that a long and laborious class of experiments have been undertaken by the Government, to determine how the future navy of England shall be built, how it should be armed, and under what conditions it can best maintain the supremacy of the seas. This question does not exclusively confine itself to armour-plated vessels, but also to the construction of ships which, in every case, should be strong and powerful enough to contend against either winds and waves or to battle with the enemy. It is for these reasons that I have ventured to direct attention to the strength of vessels, and to show that some of our mercantile ships are exceedingly weak, arising probably from causes of a mistaken economy on the one hand, or a deficiency of knowledge or neglect of first principles on the other.

Now, it is evident that our future ships of war of the first class must be long and shallow; moreover, they must contain elements of strength and powers of resistance that do not enter into the construction of vessels that are shorter and nearly double the depth. If we take a first-rate ship of the present construction, such as the *Duke of Wellington*, and compare it with one of the new or forthcoming construction, carrying the same weight of ordnance, we should require a vessel nearly twice the length and little more than half her depth. Let us, for example, suppose the *Duke of Wellington* to be 360 feet long and 60 feet deep, and the new construction 500 feet long and 46 feet deep; we should then have for the resistance of the *Duke of Wellington* to a transverse strain tending to break her back:

$$W = \frac{a d c}{l}$$

Taking 60 as the constant, and the area of the bottom and upper deck as 1060 square inches, we have

$$W = \frac{1060 \times 60 \div 60}{340} = 12,223 \text{ tons}$$

as the weight that would break her in the middle. Let us now take the new ship, and give her the same area top and bottom, and again we have

$$W = \frac{1060 + 46 \times 60}{500} = 5851 \text{ tons,}$$

which is less than half the strength. From this it is obvious—if we are correct in our calculations—that the utmost care and attention is requisite in design and construction to ensure stability and perfect security in the build of ships.

Mechanical Properties of Iron.—It is unnecessary to give more examples in regard to strength, and the proportions that should be observed in the construction of our future navy. I have simply directed attention to it as a subject of great importance, and one that I am satisfied will receive careful consideration on the part of the Admiralty and the Comptroller of the Navy.

The next question for consideration is, the properties of iron best calculated to resist the penetration of shot at high velocities, and in this I am fortunate in having before me

* See Vol. I. of the "Transactions of the Institution of Naval Architects," on the Strength of Iron Ships.

the experiments of the Committee on Iron Plates, which may be enumerated as under:—

Specific Gravity.	Tensile Strength in Tons per Square Inch.	Compression per Unit of Length in Tons.	Statical Resistance to Punching in Tons; 1-inch Plate.
7-7621	24-802	14-203	40-1804

Remarks.—The specimens subjected to compression gradually squeezed down to one-half their original height, increasing at the same time in diameter till they attained 90 tons on the square inch.

In these experiments, four descriptions of iron were selected, marked A, B, C, D; the two first and last were taken from rolled and hammered iron plates, excepting C, which was homogeneous, and gave higher results to tension and dead pressure than the others.

In destiny and tenacity they stood as follows:—

Mark on Plates.	Density.	Tenacity in Tons.
A Plates	7-8083	24-644
B Plates	7-7035	23-354
C Plates, homogeneous ...	7-9042	27-032
D Plates	7-6322	24-171

Here it will be observed, that the strengths are in the ratio of the densities, excepting only the B plates, which deviate from that law.

On the resistance to compression, it will be seen that in none of the experiments was the specimen actually crushed; but they evidently gave way at a pressure of 13 tons per square inch, and were considerably cracked and reduced in height by increased pressure.

From the experiments on punching, we derive the resistance of A, B, C, D plates to a flat-ended instrument forced through the plate by dead pressure as follows:—

Mark on Plates.	Shearing Strain in Tons per Square Inch.	Ratio, taking A as Unity.
A Plates	19-511	1-000
B Plates	17-719	0-907
C Plates	27-704	1-168
D Plates	17-035	0-873

Here may be noticed, that the difference between the steel plates of series C, and the iron plates of series A, is not considerable, though in all others the steel plates exhibit a superiority in statical resistance.

Having ascertained, by direct experiment, the mechanical resistance of different kinds of iron and steel plates to forces tending to rupture, it is interesting to observe the close relation which exists between not only the chemical analysis as obtained by Dr. Percy, but how nearly they approximate to the force of impact, as exhibited in the experiments with ordnance at Shoeburyness.

Dr. Percy, in his analysis, observes that of all the plates tested at Shoeburyness, none have been found to resist better than those lettered A, B, C, D, with the exception of C. The iron of plate E contained less phosphorus than either of the three, A, B, D; and it is clearly established that phosphorus is an impurity which tends in a remarkable degree to render the metal "cold short," *i.e.*, brittle when cold.

The following table shows the chemical composition of these irons:—

Mark.	Carbon.	Sulphur.	Phosphorus.	Silicon.	Manganese.
A	0-01636	0-104	0-106	0-122	0-28
B	0-0327	0-121	0-173	0-160	0-029
C	0-023	0-190	0-020	0-014	0-100
D	0-0436	0-118	0-228	0-174	0-250
E	0-170	0-0577	0-0894	0-110	0-330

Comparing the chemical analysis with the mechanical properties of the irons experimented upon, we find that the presence of 0-23 per cent. of carbon causes brittleness in the iron; and this was found to be the case in the homogeneous iron plates marked C; and although it was found equal to A plates in its resistance to tension and compression, it was very inferior to the others in resisting concussion or the force of impact. It therefore follows that toughness combined with tenacity is the description of iron plate best adapted to resist shot at high velocities. It is also found that wrought-iron, which exhibits a fibrous fracture when broken by bending, presents a widely different aspect when suddenly snapped asunder by vibration, or by a sharp blow from a shot. In the former case the fibre is elongated by bending, and becomes developed in the shape of threads as fine as silk, whilst in the latter the fibres are broken short, and exhibit a decidedly crystalline fracture. But, in fact, every description of iron is crystalline in the first instance; and these crystals, by every succeeding process of hammering, rolling, &c., become elongated, and resolve themselves into fibres. There is, therefore, a wide difference in the appearance of the fracture of iron when broken by tearing and bending, and when broken by impact, where time is not an element in the force producing rupture.

If we examine with ordinary care the state of our iron manufacture as it existed half a-century ago, we shall find that our knowledge of its properties was of a very crude and most imperfect character. We have yet much to learn, but the necessities arising from our position as a nation and the changes by which we are surrounded, will stimulate our exertions to the acquisition of knowledge and the application of science to a more extended investigation of a material destined, in course of time, to become the bulwark of the nation. It is, therefore, of primary importance, that we should make ourselves thoroughly acquainted not only with the mechanical and chemical properties of iron, but that we should moreover be able to apply it in such forms and conditions as are best calculated to meet the requirements of the age in which we live.

Entertaining these views, I cheerfully commenced with my talented colleagues the laborious investigations in which we are now engaged; and looking at the results of the recent experiment with the 300-pounder gun on the one hand, and the resting targets on the other, there is every prospect of an arduous and long-continued contest.

From the Manchester experiments, to which I have alluded, we find that with plates of different thicknesses, the resistance varies directly as the thickness, that is, if the thickness be as the numbers 1, 2, 3, &c., the resistance will be as 1, 2, 3, &c.; but those obtained by impact at Shoeburyness show that, up to a certain thickness of plate, the resistance to projectiles increases nearly as the square of the thickness. That is, if the thickness be as the numbers 1, 2, 3, 4, &c., the resistance will be as the numbers 1, 4, 9, 16, &c., respectively. The measure therefore of the absolute destructive power of shot is its *vis viva*, not its momentum, as has been sometimes supposed, but the work accumulated in it varies directly as the weight of the shot multiplied into the square of the velocity.

There is therefore a great difference between statica pressure and dynamical effect; and in order to ascertain the difference between flat-ended and round-ended shot, a series of experiments were undertaken with an instrument or punch exactly similar in size and diameter and precisely corresponding with the steel shot of the piece .85 diameter employed in the experiments at Shoeburyness. The results on the A, B, C, and D plates are as follows. (See next page.)

These figures show that the statical resistance to punching is about the same, whether the punch be flat-ended or round-ended, the mean being in the ratio of 1,000 : 1,085 or 8½ per cent. greater in the round-ended punch. It is, however, widely different when we consider the depth of indentation of the flat-ended punch, and compare it with that produced by the round-ended one,

Character of Plates.		Resistance in lbs.	
		Punch flat-ended.	Punch Round-ended.
Half-inch thick	A Plates ...	57,956	61,886
	B Plates ...	57,060	48,788
	C Plates ...	71,035	85,524
	D Plates ...	46,080	43,337
Three-quarter-inch thick ...	B Plates ...	84,587	98,420
	D Plates ...	82,381	98,571
Mean		67,017	72,754

which is $3\frac{1}{2}$ times greater. Hence we derive this remarkable deduction, that whilst the statical resistance of plates to punching is nearly the same, whatever may be the form of the punch, yet the dynamic resistance or work done in punching is twice as great with a round-ended punch as with a flat-ended one. This of course only approximately expresses the true law; but it exhibits a remarkable coincidence with the results obtained by ordnance at Shoeburyness, and explains the difference which has been observed in these experiments, more particularly in those instances where round shot was discharged from smooth-bored guns at high velocities. To show more clearly the dynamic effect or work done by the weight of shot which struck some of the targets at different velocities, the following results have been obtained:—

TARGET.	Weight of Shot striking Target.	Work done on Target.	
		Total.	Per Square Foot.
		lbs. Foot lbs.	Foot lbs.
Thornycroft 8-inch Shield . .	1253	—	29,078,000
Thornycroft 10-in. Embrasure	1511	—	37,140,000
Roberts's Target	946	822,000	19,726,000
Fairbairn's Target	1024	324,000	23,311,000
Warrior Target	3229	312,000	62,570,000
The Committee's Target . .	6410	—	124,098,780

From the above, it will be observed, that the two last targets have sustained in work done what would, if concentrated, be sufficient to sink the largest vessel in the British navy.

We are all acquainted with the appearances and physical character of artillery, but few are conversant with the nature of the operations and the effects produced by shot on the sides of a ship or on resisting forts and targets.

The shot of a gun—to use the expression of my colleague, Mr. Pole—is simply the means of transferring mechanical power from one place to another. The gunpowder in the gun develops by its combustion a certain quantity of mechanical force, or work as it is now called, and the object of the shot is to convey this work to a distance, and apply it to an object supposed to be otherwise inaccessible. The effect of this, according to Mr. Pole's formula, is—

W = its velocity in feet per second.

V = weight of the shot in lbs.

Then, by the principle of *vis viva*, the quantity of work stored up by the moving mass, measured in lbs. one foot high, is—

$$\frac{W V^2}{2g}$$

g being the force of gravity = $32\frac{1}{2}$.

Thus, if we have a shot, like that recently used against the *Warrior* target, 156 lbs., moving at the rate of 1,700 feet per second, the work done will be—

$$\frac{156 + (1,700)^2}{64\frac{1}{2}} = 7,008,238 \text{ one foot high.}$$

Showing at once the immense power that this small body is able to deliver on every resisting medium tending to arrest its course and bring its particles to a state of rest. Or, in other words, it is equivalent to raising upwards of 3,000 tons a foot high in the air.

The Application of Iron for Purposes of Defence.—Having examined, in a very condensed and cursory manner, the present state of our knowledge in regard to iron, and its application to the purposes of shipbuilding, let us now consider in what form and under what circumstances it can best be applied for the security of our vessels and forts. To the latter the answer is, Make the battery shields thick enough: but a very different solution is required for the navy, where the weight and thickness of the plates is limited to the carrying powers of the ship. It has been observed with some truth that we have learnt a lesson from the recent naval action on the American waters; but it must be borne in mind that neither of the vessels engaged nor the ordnance employed were at all comparable to what have been used at Shoeburyness.

To those who, like myself, have gone through the whole series of experiments, the late engagement will appear instructive, but not calculated to cause any great alarm, nor yet effect any other changes than those primarily contemplated by the Government, and such as have been deduced from our own experiments. It is, nevertheless, quite evident that our future navy *must be entirely of iron*; and, judging from the last experiment with the Armstrong smooth-bore gun, it would almost appear as a problem yet to be solved, whether our ships of war are not as safe without iron armour as with it. If our new construction of ships are strong enough to carry armaments of 300-pounder guns, which is assumed to be the case, our plating of 6 or 7 inches thick would be penetrated, and probably become more destructive to those on board than if left to make a free passage through the ship. In this case we should be exactly in the same position as we were in former days with the wooden walls; but with this difference, that if built of iron the ship would not take fire and might be made shell proof. It is, however, very different with forts, where weight is not a consideration, and those I am persuaded may be made sufficiently strong to resist the heaviest ordnance that can be brought to bear against them. In this statement I do not mean to say that ships of war should not be protected; but we have yet to learn in what form this protection can be effected to resist the last powerful ordnance, and others of still greater force which are *looming in the distance*, and are sure to follow.

A great outcry has been raised about the inutility of forts; and the Government, in compliance with the general wish, has suspended those at Spithead: I think improperly so; as the recent experiments at Shoeburyness clearly demonstrate that no vessel, however well protected by armour-plates, could resist the effects of such powerful artillery; and instead of the contest between the *Merrimac* and the *Monitor*, and that of the 300-pounder gun being against, they are to every appearance in favour of forts. Should this be correct, we have now to consider how we are to meet and how resist the smashing force of such powerful ordnance as was levelled against the 'Warrior' target.

During the whole of the experiments at Shoeburyness I have most intently watched the effects of shot on iron plates. Every description of form and quality of iron has been tried, and the results are still far from satisfactory; and this is the more apparent since the introduction of the large 300-pounder, just at a time when our previous experiments were fairly on the balance with the 40, 68, 100, and 126-pounders. They now appear worthless, and nothing is left but to begin our labours again *de novo*.

It has been a question of great importance, after having determined the law of resistance and the requisite quality of the iron to be used as armour-plates, how these plates should be supported and attached to the sides of the ship. Great difference of opinion continues to exist on this

subject,—some are for entirely dispensing with wood; probably the greater number contend for a wood backing, the same as the *Warrior* and the *Black Prince*. I confess myself in the minority on this question; and, judging from the experiments, I am inclined to believe from past experience that wood combined with iron is inferior to iron and iron in its power of resistance to shot; and I am fully persuaded that ultimately the iron armour-plates must be firmly attached to the side, technically called the skin, of the ship. It must, moreover, form part of the ship itself, and be so arranged and jointed as to give security and stability to the structure.

The experiments instituted by the Committee on Iron Plates have been well considered and carefully conducted: they commenced with a series of plates selected from different makers, of varying thicknesses, and these have been tested both as respects quality and their powers of resistance to shot. They have, moreover, been placed at different angles and in a variety of positions, and we had just arrived at the desired point of security, when the thundering 300-pounder smooth bore upset our calculations and levelled the whole fabric with the ground. We are, however, not yet defeated; and true to the national character, we shall, like the knights of old, resist to the last—

“And though our legs are smitten off,
We'll fight upon our stumps.”

And thus it will be with the Iron Committee and the Armstrong and the Whitworth guns.

In conclusion, allow me to direct attention to a drawing of the ‘Warrior’ target, with wood backing and its compeer entirely of iron. The first underwent a severe battering, previous to the attack from the 300-pounder, but the other sustained still greater, with less injury to the plates, notwithstanding the failure of the bolts in the first experiment. It must, however, be admitted that plates on wood backing have certain advantages in softening the blow, but this is done at the expense of the plate, which is much more deflected and driven into the wood, which, from its compressibility, presents a feeble support to the force of impact. Again, with wood intervening between the ship and the iron plates, it is impossible to unite them with long bolts so as to impart additional strength to it; on the contrary, they hang as a dead weight on her sides with a constant tendency to tear her to pieces. Now, with iron on iron we arrive at very different and superior results. In the latter, the armour-plates, if properly applied, will constitute the strength and safety of the structure; and, notwithstanding the increased vibration arising from the force of impact of heavy shot, we are more secure in the invulnerability of the plates and the superior resistance which they present to the attack of the enemy's guns. In these remarks I must not, however, attempt to defend iron constructions where they are not defensible, and I am bound to state that in constructions exclusively of iron there is a source of danger which it is only fair to notice, and that is, that the result of two or more heavy shot, or a well concentrated fire, might not only penetrate the plates but break the ribs of the ship. This occurred in the last experiment on my own target, where a salvo of six guns concentrated four on one spot, not more than 14 inches diameter, went through the plates and carried away a part of the frame behind. The same effect might have taken place on the ‘Warrior’ target; and certainly 9 inches of wood is of little value when assailed by a powerful battery of heavy ordnance and a well concentrated fire.*

* Since the above was written, another experiment has been made on the ‘Warrior’ target with the 300-pounder smooth-bore gun. From this it appears that the wood backing between the armour plates and the skin of the ship cannot safely be dispensed with, and that some compressible or softer substance than iron and iron is necessary to deaden the blow, and absorb the fragments of the shot and the broken plates, which in this instance lodged in the wood, and did not perforate, but only

In closing these remarks, I have every confidence that the skill and energy of this country will keep us in advance of all competitors, and that a few more years will exhibit to the world the Iron Navy of England, as of old, with its Wooden Walls, unconquerable on every sea.

SUBJECTS FOR DISCUSSION CLASSES IN INSTITUTIONS.

The following list has been prepared, partly from returns forwarded by the Institutions in Union with the Society, and partly from various other sources. It is published in the hope that it may be useful to the managers of Discussion Classes, in suggesting suitable subjects for discussion.

HISTORY.

Did St. Paul ever visit Great Britain?

Which was the greater warrior—Alexander the Great or Julius Cæsar?

Ancient and modern greatness.

Which contributed most to the success of the Mahometans, the decline of the Martial Spirit among Eastern nations, or the enthusiasm inspired by the creed of Mahomet?

Was Mahomet an Impostor?

St. Gregory the Great—the Popedom of the 6th century.

Which monarch did more in his reign for the advancement of civilisation, Alfred the Great or William the Conqueror?

Which did the more good to his country, Charlemagne or Alfred the Great?

Had William the Conqueror any right to the British Throne?

Did the Norman Conquest prove beneficial to England or not?

Were the Crusades beneficial to Mankind?

Had Bruce or Balliol the better claim to the Throne of Scotland?

Was Wallace or Tell the greater Patriot?

Was Edward I. justifiable in taking the life of Wallace?

Were the Wars of the Roses justifiable?

Which had the greater right to the Crown of England, the House of York or the House of Lancaster?

Was Joan of Arc an impostor?

Was Wat Tyler's insurrection justifiable?

Was the secularization of the revenues gained by suppressing the Monasteries under Henry VIII. a wanton violation of the rights of property?

Which was the greater man, Cardinal Ximenes or Cardinal Wolsey?

The reign of Mary I. retarded the Reformation for a season. Was that delay productive of good or evil?

Was Queen Elizabeth justified in executing Mary Queen of Scots?

Is the character of Queen Elizabeth worthy of admiration?

Was Sir Walter Raleigh justly executed?

The character of Lord Bacon.

Was the execution of Lord Strafford justifiable?

The policy of the Stuarts.

cracked the skin of the target. From this fact it cannot be denied that this experiment is more satisfactory than those on the iron on iron targets; and however desirable it may be to realize a more effective construction as regards the strength of the ship, it cannot be doubted in so far as the security of the ship and the lives of those on board are concerned, that a vessel with wood backing is safer in action than one composed entirely of iron. In the present state of our knowledge the experiments are therefore against iron and iron, as regards security from the effects of shot, but they are unfavourable as respects the strength of the ship.

Were the long Parliament justified in declaring War against Charles the First?

Did circumstances justify the Execution of Charles I.?

Was Cromwell justified in the massacre of Drogheda?

The Character of Cromwell as warrior, statesman, and man.

Is Cromwell justly charged with hypocrisy?

Is a debt of Gratitude due to General Monk for restoring Royalty?

Was the expulsion of James II. justifiable or not?

Was the character of the Duke of Marlborough to be admired?

Has the union of Scotland with England proved beneficial to the former country?

Which best merited the title of "Great," Henry IV. or Louis XIV.?

Which did the most to produce the French Revolution, the tyranny of the Government, the excesses of the higher orders, or the writings of Voltaire, Montesquieu, and Rousseau?

Did the first French Revolution produce a beneficial influence on Europe?

Was the Execution of Louis XVI. an act of justice?

Was Charles Edward justly called the Pretender?

Were the United States in America justified in revolting?

Did England suffer or gain by losing America?

Was Admiral Byng justly executed?

Clive and Hastings compared.

Was Warren Hastings' Rule in India such as merited the opprobrium cast upon him by Burke and his supporters?

Was Fox or Pitt the greater Man?

Was the English Government justified in transporting Napoleon to St. Helena?

Which has produced most great men—the last half of the 17th or the first half of the 18th century?

Are the Dark Ages deserving the ignominy usually cast upon them?

Is the charge of Extravagance in Dress as applicable to the present as to past ages?

Have England's Conquerors or her Conquests most conduced to her greatness?

Was the expulsion of the Moors from Spain unfavourable to civilisation?

Was the partition of Poland justifiable?

Excellence in the Fine Arts is not evidence of the Decline of a State.

Is Macaulay's "History of England" deficient in many of the characteristics of a good history?

Do we, or did our ancestors of the "good old time," enjoy a greater amount of social happiness?

Has moral progress in England kept pace with the increase of material wealth?

Does commercial prosperity strengthen or effeminate a country?

Is the ordinary notion that a nation cannot stand still in its civilisation correct or not?

Will England continue to be a promoter of, and permanent resting place for, the Arts and Sciences?

Is it easier to obtain a position of eminence now than it was a century ago?

Has the discovery of Gunpowder been beneficial to mankind?

The steam engine or the printing press—Which has done most for civilisation?

POLITICS.

Whether the Feudal or Commercial System has been most favourable to the development of high principles?

Is an hereditary monarchy preferable to an elective one?

Which is preferable, Centralization or Local Government?

Ought a Member of Parliament to vote according to his own opinions or those of his constituency?

Is Universal Suffrage desirable?

Is the educational franchise worthy of adoption?

What are the proper functions of a Government?

Ought the Government to lead public opinion or be led by it?

Is the Union of Church and State desirable?

Is the admission of military and naval men into civil governments beneficial?

Is the continued accession of territory to England in India necessary and expedient?

Were the means by which our Indian Empire was acquired consistent with sound national polity?

Is the retention of India conducive to the welfare of the British Empire?

Are the Natives of India justified in their attempts to throw off the British yoke?

What are the best means to be adopted for the abolition of slavery?

Is Monarchy more favourable than Democracy to excellence in the Arts and Sciences?

Is consistency in public men on the decline?

Do sudden reforms usually tend to advance the interests of the community?

Was the statesmanship of the late Sir Robert Peel conducive to the welfare of Great Britain?

Is Emigration beneficial, and how should it be conducted?

Is the influence of Society on Government greater than that of Government on Society?

Is Russia entitled to rank among the civilised nations?

Is a nation better for having enemies?

Has England those elements of decay which characterised the nations of antiquity?

Ought the Press to be entirely Free from State control?

Ought Government to interfere with the liberty of the Press, when that liberty is used for the purposes of immorality?

POLITICAL ECONOMY.

Is self-interest the right basis for Commercial action?

Competition—Co-operation—Which principle is best adapted to the Present State of Society?

Is exclusive monopoly a greater evil than reckless competition?

Would a community of goods promote the welfare of man?

Ought money to be intrinsic or symbolical?

Is direct or indirect taxation the better mode of levying for purposes of revenue?

Is the National Debt to be considered a grievance?

Under what circumstances is it desirable to maintain a surplus revenue for the purpose of paying off a National Debt?

To what extent is the pressure of the National Debt of this country lessened by mitigating circumstances, arising out of the facilities which it affords to certain kinds of business?

Is there a tendency in nations to attain a stationary condition of Wealth?

Should commercial privileges be granted by one nation to another otherwise than on the principle of reciprocity?

Can one nation become richer without another becoming poorer?

According to what principle is the benefit of the trade between two nations shared between those two nations?

Would a reduction of the import duties upon the produce of foreign countries, if unaccompanied by an equivalent reduction upon British goods in foreign ports, have the effect of altering the distribution of the precious metals to the disadvantage of this country, and of causing the produce of a given quantity of British labour to be exchanged for the produce of a less quantity of Foreign labour?

Ought taxation to press equally on the capital of skill and the capital of property?

Is it beneficial or injurious that vagrants begging from door to door should be relieved?

Is Capital or Labour the more valuable instrument of production?

The economy of labour—how has it affected the working classes?

Are Trade Unions as at present constituted the best means of obtaining a fair day's wages for a fair day's work?

Are strikes beneficial to the working man?

Have the working classes been benefited by machinery?

Are the "Art Union" lotteries contrary to sound principles of trade, and destructive of a healthy moral tone amongst the community?

What are the distinctions to be properly drawn between Free Trade and *Laissez Faire*?

What are the objections to a circulation of One Pound notes, issued by the Bank of England and by the Provincial Bankers?

What are the mode and degree in which the facilities afforded by railways in this country have led to a saving of capital and to a diminution of cost of production?

What effects has the observance of the Seventh Day had on the production and distribution of Wealth?

To what extent does Quantity as well as Cost of Production determine the exchangeable value of Gold and Silver?

Are there at present pressing on Industry and Production in this country any considerable direct or indirect Taxes, which admit of being greatly reduced or wholly removed without serious injury to the Revenue?

To what extent, if any, have the Poorer Classes of this Country partaken of the large increase in wealth, and its attendant conveniences, during the last hundred years?

To what extent, if any, have the recent discoveries of Gold affected its value in relation to other commodities?

What is the nature of the process by which the influx of the New Gold from California and Australia has added, and is adding, to the Real Wealth of the World?

Is there good reason to believe that, under the present circumstances of this country, the best provision that can be made for lessening the burden of the National Debt consists in removing oppressive Fiscal Taxes, so as to increase the ability of the country to provide the annual interest?

Is there any adequate reason for authorizing or permitting the issue of paper currency, not representing actual deposits of coin or of the precious metals?

Is there any adequate foundation for the doctrine that the issue of Bank Notes is an exclusive function or prerogative of the Sovereign or State?

Are there any valid objections to the application of Limited Liability to Joint Stock Banks?

Instead of instituting Courts for facilitating the recovery of Small Debts, would it be better to place them beyond the pale of the law?

Is it expedient that Government should concentrate labour in a New Colony by laying a price on land?

What would be the effect on the wealth of Great Britain, if all the principal landholders and stockholders were to devote all their revenues, beyond their own subsistence, to productive purposes?

In the absence of disturbing causes is it more likely that—in a given country—population will increase more rapidly than subsistence, or subsistence more rapidly than population?

Are there any circumstances to be conceived, in the situation of Great Britain, to render a free trade with France otherwise than beneficial to both countries?

Under what circumstances is the absenteeism of landed proprietors detrimental to the wealth of a country?

Is it expedient that the legislature should in any, and what cases, interfere in contracts between the employer and labourer, to regulate the hours and mode of labour?

Are there any good grounds for thinking that either the wealth or prosperity of Great Britain would be at all impaired by Canada becoming independent, or being incorporated with the United States?

Which is best, a tax upon property, upon income, or upon expenditure?

Does taxation on the commodities consumed by the

labourer, raise wages under any, and what, circumstances?

What is the most equitable mode of assessing an Income Tax?

Is there sufficient reason for the popular assumption that the progress of British prosperity is seriously checked by the pressure of existing Taxation?

Is there any, and what, ground for the dictum of Adam Smith, that the Foreign trade of a country gives less encouragement to its industry or productive labour than is afforded by its Home trade?

On what principle should privileges or rewards be granted in respect of Inventions?

Are Copy-right and Patent-right founded on justice, or merely on sufferance, and are those terms misnomers?

Does that law which gives to Inventors the monopoly of their Invention for a certain number of years thereby cause the amount of National Wealth to be greater than it would be, were no such exclusive privilege conceded to Inventors?

Can it, under any circumstances whatever, be advantageous to raise the money required for the public expenditure by means of a Loan, instead of immediate taxation?

Under what circumstances are Governments justified in distributing the present charges of Wars, by loans payable by people who have not undertaken them?

Are there any, and what, limits to the principle, that the physical wants of the community are best supplied by the agency of competition?

To what partnerships should the principle of Limited Liability extend, and with what Safeguards should it be attended?

Are there any circumstances in the progress of Arts and Manufactures which tend to Maintain or to Advance Wages, irrespective of the number of Labourers in the Market?

What are the legitimate limitations, if any, on economical grounds, to the absolute power of disposing of property by Will?

What would be the effects on the production and distribution of Wealth, if the owners of Property were further restrained from settling it, or from preventing, for long periods after their decease, the absolute Ownership from becoming vested?

What in this country would be the probable Economical consequences of a Government based on Universal Suffrage?

To what extent, if any, is it justifiable or advisable to depart from the strict rules of Political Economy, in dealing with the Social Condition of a people?

Is the distribution of Newspapers and Books by the Post-Office at variance with the principles of Political Economy, and, if not, would it be any violation of those principles to employ the machinery of the department in the distribution of small parcels generally?

In the present state of railway enterprise in this country, how far is it true that the public convenience and profit may be best advanced by promoting the amalgamation of Lines, with a view to a Regulated Monopoly, rather than by encouraging competition in the ordinary sense?

What are the considerations, if any, which should induce a Country to discourage or prevent the exportation of Commodities in the production of which it possesses pre-eminent or exclusive advantages?

If financial necessities or readjustments should compel an early recourse to increased Taxes, what kind of new, or what addition to existing, Taxes would be open to the least objection?

What are the causes which prevent the Poorest Classes in this country from enjoying a larger Share in the advantages of our increasing Wealth and the progress of Improvement?

Are there any good grounds for believing that it would be possible in this Country largely to establish any arrangements or plans under which Persons Employed may share, to a greater or smaller extent, in the profit and loss results of the business carried on by their Employers?

Are there any reasons for believing that a law designed to diminish the prevalence of Credit in this country, by denying legal validity to debts of longer standing than three months, would be economically advantageous?

SOCIAL SCIENCE AND THE AMENDMENT OF THE LAW.

What are the best means of improving the condition of the working classes?

Is it the duty of the municipal authorities of large towns to provide suitable homes for the working classes?

The Amendment of the Physical should precede that of the Mental and Moral condition of the Masses.

Is the welfare of a people promoted better by individual or associative efforts?

Is it desirable that the different trades, professions, and clerkships should be thrown open for the employment of women?

Should literary and scientific occupation be followed by the female sex in order to their maintenance?

If facilities were afforded for ladies to study and practise as Physicians, would it be beneficial to the community?

Would a Legislative Enactment for the Observance of stated National Holidays conduce to the Physical, Moral, and Religious well-being of the Community?

Would the general adoption of early closing conduce to the social and moral elevation of the classes intended to be benefited by it?

Would the revival of national sports tend to the improvement of English character?

Does morality increase with civilisation?

Should our law relating to refugees and aliens be altered?

Should the public sale of intoxicating liquors be restricted by Law?

Are Pawnbrokers a public evil or a public good?

Is the present system of Apprenticeship based upon sound principles?

Would it be better for society if men sought the happiness of others in preference to their own?

Is the principle of life assurance worthy the support of the working classes?

Would it be advisable to introduce a Decimal System of Coins, Weights, Measures, and Accounts into this country?

Which is the more injurious to society—the spendthrift or the miser?

Is poverty or wealth the greater incentive to crime?

With the object of preventing fraud and over-speculation, should the laws which relate to commerce be more stringent?

Would the abolition of the Law of Primogeniture be beneficial to Society?

Ought capital punishments to be abolished?

Is the establishment of a court of criminal appeal desirable?

Should Quackery be prohibited, and penalties inflicted by Law?

Should cases of Insolvency be settled solely by Tribunals of Commerce, without the intervention of lawyers?

Should Insanity be allowed as a ground of acquittal, or of mitigation of punishment?

Should the system of granting Tickets-of-leave to Criminals be abolished?

Should a unanimous verdict be required from juries?

Ought imprisonment for debt to be abolished?

ETHICS.

Is an advocate justified in pleading the cause of one whom he knows to be guilty?

Does effectual Revenge or meek Endurance of Injuries indicate the greater strength of mind?

Ought the conduct of a man to be influenced by Public Opinion?

Is man's will entirely controlled by circumstances?

Can any circumstances justify a departure from the truth?

Is ambition a vice or a virtue?

How far is war justifiable?

EDUCATION, SCIENCE, &c.

Ought Government to provide Education for the people? Ought the Education of the people to be under the control or regulation of a public office?

Is a general, and consequently a comparatively superficial, knowledge more conducive to the happiness of individuals than one that is more limited and profound?

Is a classical education the best training for commercial men?

Which are of the greater importance in Education, the Classics or Mathematics?

Is the study of History of more importance to a young man than that of Science?

Which is the more conducive to the improvement of the mind—the study of History or the reading of Poetry?

Is the cultivation of Music beneficial as a branch of National Education?

Ought Social Economy to form a subject of Elementary Instruction in Public Schools?

Should Education be conducted on a system which admits of rewards, punishments, and emulation?

In school discipline is the infliction of corporeal punishment justifiable?

Is the education of the present day calculated to prevent crime?

What system of education is best suited to elevate the rising generation?

Is the reading of light literature prejudicial to the formation of good habits?

Do satirical writings and the public personification of defects of character exercise a good influence on National Character and Public Morality?

In what manner, under present circumstances, may Science and Learning be best promoted in England by the application of private funds, and by the intervention of the Government?

Should Science rather than the Fine Arts form a portion of National Education?

Would the more general study of the Fine Arts tend to the moral elevation of the people?

Is the influence of the drama beneficial?

Can thought be better expressed by Sculpture than by Painting?

Of Painting and Poetry which is the greater art?

Was the poet right when he said,—

“A little learning is a dangerous thing!”

Has the progress of modern art produced a good moral effect on national and individual character?

Is the faculty of Reason confined to Man?

Is it probable the Planets are inhabited?

Whether Creed or Climate has the greater influence on mankind?

Has Nature or Education the greater influence in the formation of character?

Is Education or Wealth most calculated to promote the happiness of man?

Does Engagement in Trade or Manual Labour necessarily prevent a man becoming successful in a mental pursuit?

LITERATURE.

Is the English language more indebted to its poet than its prose writers?

Are the moderns or the ancients the truer poets?

Was Shakspeare a greater tragedian than comedian?

The merits of Shakspeare and Milton as poets.

The English poets from Chaucer to Milton are superior to the modern.

British Essayists of the last century.

Cowper—his life and poems.

Which was the greater poet—Byron or Burns?

Was Sir Walter Scott, as a Poet, superior to Lord Byron?

The philosophy of Goethe's "Faust" is equal to that of "Macbeth."

The serious side of Charles Dickens.

What is the moral tendency of the writings of Charles Dickens?

Which has the greater power in the delineation of human character—Dickens or Bulwer?

Longfellow and his poems.

Are the moral, intellectual, and social tendencies of the literary satirists of the past fifty years more salutary and effective than those of the preceding?

Is the cheap literature of the age on the whole beneficial to general morality?

MISCELLANEOUS.

Are we better servants of our times by being contented or discontented with them?

Do circumstances make men, or men make circumstances?

Is the tendency of Field Sports beneficial?

Love of country; is it inherent in men?

Which character is the more to be admired, Dr. Arnold or the Rev. Sidney Smith?

Do great men make the age or the age great men?

Is procastination or precipitancy the greater evil?

When does man experience most happiness—in the pursuit or the attainment of an object?

Which country is most suitable for colonisation, Canada or Australia?

Which profession gives the best opportunities of judging of human character, Divinity, Law, or Physic?

Is it possible for man to act without consideration of his own gratification or advantage?

Is military renown a fit object of ambition?

Ambition or curiosity—which has led to the more important discoveries?

Literary fame or military glory—which tends more to immortalise a man's name?

Which tends more to elevate character—the proverbial bluntness of the English or the refined courtesy of Continental nations.

The Man of Action—the Man of Thought—which is the more Useful to Society?

Which is the more valuable member of society, a great mechanician or a great poet?

Are the intellectual qualities of the sexes equal?

Ought a youth to have choice of his own pursuit in life?

Does Moral or Money power exercise the greater influence on the Human mind?

Which exercises the greater influence in the civilisation and happiness of the human race, the male or the female mind?

Do we derive the greatest amount of pleasure from Hope or Memory?

Whether malice or thoughtlessness has been productive of most evil in the world?

Has the fear of punishment or the hope of reward the greater influence on human conduct?

From which does the mind gain the more knowledge, reading or observation?

Which does most to make the Orator—Knowledge, Nature or Art.

Is Example without Precept more powerful than Precept without Example?

Liberty—the meaning and value of the word.

What would be the best means of making Mechanics' Institutions more popular?

The following publications may be read with advantage by young men desirous of cultivating the faculty of extempore speaking:—

Practical Hints to Unpractised Lecturers to the Working Classes. By Benjamin Scott, Secretary to the Working Men's Educational Union. Baron, 25, King William-street, West Strand (1854); pp. 30, 6d.

The Speaker at Home; or Chapters on Public Speaking and Reading Aloud. By the Rev. J. J. Holcombe, M.A. Belland Daldy, 186, Fleet-street; pp. 180, 3s. 6d.

The Art of Extempore Speaking. By M. Bontain. (Translated from the French.) Bosworth, 215, Regent-street; pp. 300, 5s. (This is a treatise of great ability.)

The following brief extracts from the rules of an existing debating club may be found useful:—

"It shall be the object of the class to encourage, as far as possible, rather a regulated conversational discussion of the questions brought before it, than the delivery of formal speeches. No member, however, shall be entitled to speak twice on the same question, save its proposer, who shall have a right of reply. Lengthy written papers also shall be considered as inadmissible.

"Each meeting shall appoint its own chairman for the evening.

"Without being precisely a matter of absolute obligation, it shall be considered the duty of each member to introduce a question, as far as practicable, in his turn.

"The committee shall, in the first instance, decide on the eligibility of the questions proposed, as fitting topics for discussion. It shall be a standing instruction to the committee to require all questions to be worded with as much conciseness, and as accurately and carefully as possible."

Subjoined are some suggestions for promoting the efficiency of discussions in debating-classes in Mechanics' Institutes:—

1. Before a question is finally entered for discussion let the mover of it carefully consider the terms on which it is proposed, so as to render the phraseology as exact and significant as possible. This precaution would generally prevent the discussion from becoming a mere dispute about words.

2. The Chairman should have a chair, and should take some little pains to master the rules applicable to his office. A very excellent little manual on the subject is the following, "The Chairman and Speaker's Guide," by Thomas Smith. Longmans, 1s.

3. No language in the least degree discourteous should be permitted, and no imputation of motives should be allowed in any form.

4. Upon merely abstract or general questions, it is not desirable that the meeting should proceed to any vote, or record any formal division. Leave the discussion to produce its effects on individual minds.

5. It is convenient on some occasions to limit speakers to 10 or 15 minutes, but there are many subjects upon which a meeting would do well to allow a good speaker, who can really argue the case, to unfold his views at length.

6. The opener of the debate may be allowed to read from a MS, but no such privilege should be permitted to those who follow him. It is of the essence of a useful debate that it should be extemporaneous.

MECHANICS' INSTITUTES AND POPULAR RECREATION.

The committee of the Leeds Mechanics' Institution have agreed to give a prize of five guineas for the best Essay on "Mechanics' Institutes and Popular Recreations, with special reference to the question how far it is desirable to combine them." Each Essay must bear a distinguishing motto, and be sent under cover to the secretary, together with a sealed envelope bearing a similar motto, and containing the name and address of the writer, on or before the 1st of October next. The Essays will be sent for adjudication to Edward Akroyd, Esq., Halifax; John Hope Shaw, Esq., Leeds; Darnton Lupton, Esq., Leeds; and the award will be made on the 1st November.

The Essay, which should not occupy more than one hour in reading, will be read by the successful competitor in the lecture-hall of Leeds Mechanics' Institution. Competitors must be members of Institutes in the Yorkshire Union.

Home Correspondence.

RECREATION AT MECHANICS' INSTITUTES.

SIR,—The importance of making the recreation of the members a feature in the operations of Mechanics' Institutes, has, no doubt, obtained much additional publicity by the prominence which was given to it in the discussion at the recent Conference. Advantage, however, should now be taken of it by entering more into details, and obtaining as far as possible the experience of those Institutes whose experiments in this direction have been tried. For this purpose it is desirable that communications should be freely made to the *Journal*, so that in the multitude of counsellors there may be found safety. On such a question, which many believe to be fraught with danger, all experience is of some value; and now that the *Journal* is not occupied with the valuable papers read during the session of the Society of Arts, a valuable opportunity is afforded for the dissemination of much useful information.

It is true Mechanics' and similar Institutes have been established ostensibly and really for the promotion of the study of science and literature, for the encouragement of intellectual tastes, and the cultivation of the mental faculties. Wherever the desire for such objects exists to any great extent, an Institute is almost necessarily successful, for the want is felt, and the remedy eagerly sought; but, unfortunately, amongst the great majority of our population—the imperfectly educated people who live by the labour of their hands—it is the desire for mental improvement which has to be cultivated, and this is the great difficulty with which the managers of Institutes have to contend. Appeals to the presumed common-sense of working people have repeatedly been made, and glowing descriptions of the substantial advantages arising from mental culture have been given by eloquent lecturers and others. No one has disputed the justness of the conclusions drawn, or denied the greatness of the benefits promised, yet most has been in vain, because the majority of the people have wanted the self-denial, the perseverance, the determination indispensable to the acquisition of the gain desired. The advantage to be earned was great, but too remote to be appreciated, too apparently unattainable to be worth the sacrifice of present enjoyment.

That this statement is by no means an exaggeration, might be shown by reference to the most successful Mechanics' Institutes, which, confined to educational or literary efforts, leaves far more undone than it accomplishes. In some small villages, where the chief advantage of an Institute is a circulating library, the number of members may average one in ten of the population, whilst in Huddersfield, where the two Institutes number above 1,500 members, the proportion is only one in thirty-four of the population, notwithstanding the continuous and judicious labours of a model secretary and a really working committee, so that many thousands of the working people are yet unprovided for.

It has not been sufficiently borne in mind that man is a social being, depending more upon the sympathy of his fellow-men, and relying more for his enjoyment upon social intercourse than on any presumed advantage to himself from solitary occupation. Were it not for this feeling would hundreds of thousands flock to Epsom on a Derby-day for the evanescent gratification derived from the passing glimpse of a horse-race of which they know but little and care less? The working man, relieved from the toils of his daily labour, seeks for relaxation in society; and while it is practically denied him in the Institute, where

he must not talk, but read or learn, he resorts to the public-house, where he can in a great measure do as he will.

It is for these reasons that it becomes a question for the serious consideration of the managers of Institutes whether they might not largely extend their influence, and more effectually promote their real object, by paying greater attention to the tastes and inclinations, as well as the higher interests of those whom they seek to bring within their walls. If to a reading-room were added a conversation room, in which greater indulgences were permitted, the Institute, by becoming more attractive, would also become more really useful; and if no other result were accomplished than weaning so many from less innocent gratifications, one step would be gained in the right direction, and the foundation prepared for still further improvement.

At Faversham, where the employment is almost confined to the making of bricks and gunpowder, an Institute has been conducted so judiciously and so successfully that it may fairly challenge rivalry with any other. A handsome and commodious building has been erected, at a cost of about £2,000; and a monthly journal is circulated gratuitously amongst the numerous members. Its great success is chiefly attributable to the zeal and energy of Mr. F. W. Monk, the managing director; and if he would oblige your readers with some details as to his proceedings, they must supply some valuable hints and suggestions to other less favoured places.

It would be as well perhaps to start with the conviction that all the people of this country, or at least with very few exceptions, are intelligent beings, capable of being influenced for their own good; that wherever an Institute has been a failure the right means have not been tried; that the most important question for consideration is the choice of the best course to pursue; and that ultimate success is almost certain if, without too strict adherence to preconceived notions, the Institute be adapted to the wishes as well as the wants of the population.

I am &c.,
BARNETT BLAKE.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par
Numb.

Delivered on 25th June, 1862.

- 327. East India (Waste Lands); Return.
- 160. Bill—African Slave Trade Treaty.

Delivered on 26th June, 1862.

- 345. Municipal Boroughs (Ireland)—Paper.
- 348. Children in Workhouses (Ireland)—Return.
- 349. St. Catherine's Harbour (Jersey)—Return.
- 352. Army (Yeomanry Volunteer Corps)—Supplemental Estimate
- 357. National Defences—Return.
- 307 (A.). Poor Rates and Pauperism—Return (A.).
- 297. Drainage (Ireland) Bill—Minutes of Evidence, &c.
- 344. Thames Embankment Bill—Report and Evidence.
- 163. Bills—Lunatics Law Amendment.
- 164. „ Coal Mines.
- 165. „ Newspapers, &c.

Delivered on 27th June, 1862.

- 355. Emigration (North American Colonies)—Return.
- 298. East India (European Troops)—Return.
- 354. East India (Finances)—Return.
- 162. Bills—Thames Embankment (as amended by the Select Committee.)
- 167. „ Endowed Schools.
- 168. „ Fortifications (Provision for Expenses).
- 169. „ Windsor Castle (Bakelhouse)

Census of Scotland (1861)—Population Tables and Report.

Delivered on 1st July, 1862.

- 237. Loan Societies—Abstract of Accounts.
- 339. Lunatic Asylums (Ireland)—Return.
- 340. Scottish Universities—Paper.
- 341. Coals, Cinders, and Cullm, etc.—Account.
- 353. Sandhurst College—Regulations.

Delivered on 2nd July, 1862.

- 175. Bills—Tramways (as amended by the Select Committee).
- 176. „ Transfer of Land (amended).
- 177. „ Church Rates Redemption.
- 178. „ Duchy of Cornwall Lands (Completion of Arrangements).

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[From Gazette, July 4th, 1862.]

Dated 17th May, 1862.

1504. C. H. Tessier, Thurloe-place, Brompton—A new safety lock. (A com.)

Dated 23rd May, 1862.

1559. J. Ward, Radford, and J. Dewick, New Lenton, Nottinghamshire—Imp. in machinery or apparatus for the manufacture of textile or looped fabrics.

Dated 27th May, 1862.

1582. C. A. M. Durand, Penjard, France—A new kind of water mill.

Dated 31st May, 1862.

1641. A. Moreau and A. E. Ragon, Bernard-street, Russell-square—Imp. in electro-magnetic machines or apparatus.

1651. W. E. Newton, 66, Chancery-lane—Imp. in the treatment of cloth and other textures, leather, or animal tissues, for the purpose of rendering them more durable and impermeable to water and other fluids, and for producing from any firm fibrous texture, such as cloth, cotton, woollen or mixed goods, a durable artificial leather. (A com.)

1653. W. E. Newton, 66, Chancery-lane—Imp. in the construction and operation of shot proof gun towers and the working of the guns therein for sea vessels, floating harbour defences, forts, or land fortifications. (A com.)

Dated 4th June, 1862.

1691. E. Conroy, Drummond-street, Euston-square—Improved machinery for cutting corks, bungs, and such like articles.

Dated 5th June, 1862.

1695. R. Robinson, 18, Fish-street, Hull—Imp. in fire escapes, parts of which improvements are also applicable to the construction of vessels for commercial and other purposes.

Dated 10th June, 1862.

1725. T. Lister, Hipperholme, near Halifax—Imp. in the material to be employed for address-cards, visiting cards, labels, railway tickets, and other similar articles, whether for printing or writing upon.

Dated 13th June, 1862.

1762. J. Bermingham, Cork—Imp. in the construction of vessels of war, parts of which improvements are also applicable to the construction of vessels for commercial and other purposes.

Dated 16th June, 1862.

1778. F. M. Lanco, 49, Boulevard Mont Parnasse, Paris—An improved geodetic or topographic instrument, intended to combine in one all the instruments now used in surveying.

Dated 17th June, 1862.

1792. Lieut.-Col. M. Turner, Wigston, Leicestershire, and E. T. Loesly, Wood-street—Imp. in small arms and ordnance, and in sights for the same, part of which may be used for measuring distances.

Dated 19th June, 1862.

1802. W. Clark, Quadrant-road, Highbury New-park, Islington—Imp. in the manufacture of that kind of boxes known as dry goods boxes.

Dated 20th June, 1862.

1814. W. Jeffries, West Bromwich, Staffordshire—A new or improved rail for railways, and a new or improved chair or sleeper for the said rail.

1820. D. Adamson, Newton Moor, Cheshire, and L. Leigh, St. Petersburg—Imp. in the construction of steam boilers, and in apparatus connected therewith, part of which is applicable to shipbuilding.

1824. C. Osman, Chryssell-road, Brixton—Imp. in the manufacture of elastic or yielding surfaces for sitting, lying, or reclining upon, part of which improvements are applicable to other purposes.

1826. G. Gray and D. Cunningham, Whiteburn, Linlithgow—Imp. in applying a new material to be used as a substitute for the "blackening" or other materials employed in casting or moulding metals.

Dated 21st June, 1862.

1828. F. E. Schneider and J. Snider, jun., 25, Walpole-street, New Cross, Surrey—Imp. in the construction of breech-loading fire-arms.

1130. J. Taylor, Oldham—An improved "doffer" or "stripper" for carding engines for preparing cotton and other fibrous substances.

1838. F. Tolhausen, 17, Rue de Faubourg Montmartre, Paris—Imp. in apparatus for preventing collisions on railways. (A com.)

1840. J. Lawson, 2, Morris-place, Glasgow—Imp. in the manufacture of carpets and other piled fabrics.

Dated 23rd June, 1862.

1842. T. Wilson, Birmingham—A new or improved dress fastening, which said fastening is also applicable to the fastening of bands and belts in general, and to other like purposes.

1846. A. Webster, Arbroath, N.B.—Imp. in machinery or apparatus for boring slate.

1848. R. Cook, Finsbury-place South—Imp. in the construction of pianoforte actions.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1894. M. A. F. Mennons, 24, Rue du Mont Thabor, Paris—Improved means for the prevention and reduction of synovial and other swellings or tumours in the limbs of horses. (A com.)—28th June, 1862.

PATENTS SEALED.

[From Gazette, July 4th, 1862.]

July 4th.

28. J. W. Arundell.

34. J. Howden.

37. A. Warner.

40. G. Betjemann, G. W. Betjemann & J. Betjemann.

43. F. Brown.

44. F. Shaw.

45. J. Higgins and T. S. Whitworth.

46. J. Tatham.

48. A. Wallis and C. Haslam.

51. A. Heath.

56. H. Bessemer.

57. W. Bradshaw.

58. H. Cook.

59. C. W. Siemens.

60. J. Smith and S. Wellstood.

63. D. Wilson.

65. D. Wilson.

67. R. A. Brooman.

72. R. Johnson.

73. M. Wiggell.

75. J. Oates.

90. F. C. Warlich.

123. T. Myers and E. Myers.

155. H. B. Barlow.

494. T. Partridge.

870. R. Lublinski.

893. J. P. Woodbury.

967. W. E. Newton.

1164. J. C. Amos.

1190. C. E. Heinke.

1199. J. F. Allen.

1340. J. H. Johnson.

1342. B. Cooke.

1422. J. H. Johnson.

1505. E. J. Bridell.

[From Gazette July 8th, 1862.]

July 8th.

83. J. White.

85. T. Scott.

91. T. Soar, J. Belshaw, and M. Soar.

92. J. Parker, J. Wells, and B. Wells.

94. R. A. Brooman.

113. W. Cleland.

114. T. Timmins & T. Simmons.

125. J. M. Rowan.

147. E. C. Nicholson.

156. G. T. Bousfield.

167. A. J. Beer.

175. H. Owen.

203. A. Samuelson.

205. J. Lillie.

228. R. Bodmer and W. Wilson.

438. J. Nasmyth.

449. G. F. Lee.

500. J. Woodrow.

712. W. Clark.

720. H. Y. D. Scott.

735. B. Todd.

736. W. Barford.

1187. A. V. Newton.

1343. T. Cabourg.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[From Gazette, July 8th, 1862.]

June 30th.

1569. N. Ardaser.

1572. E. A. Wood & M. D. Rogers.

July 2nd.

1647. W. E. Newton.

July 3rd.

1586. J. Simon.

July 4th.

1604. C. Ingan.

1627. D. Matthews.

1629. W. H. Harfield.

1630. H. Brinsmead and J. Lawrence.

1639. C. Liffé.

1695. W. H. Harfield.

1726. W. H. Harfield.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[From Gazette, July 8th, 1862.]

June 30th.

1499. R. Muckelt.

July 4th.

1502. R. Tidmarsh.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Name.	Address.
4491	June 28	{ Blanch's Improved Wind Gauge Rifle }	William Harnett Blanch	Liverpool.
4492	" 30	{ Fore Sight... .. }	William Charles Edge	{ 13, Owen's-row, St. John-street- road, Clerkenwell.
4493	July 7	{ Fastening for securing Scarfs or Handkerchiefs }	Thomas Kemp Mace	Bull-street, Birmingham.
		{ An Improved Hat Suspender or Miscellaneous Clip }		